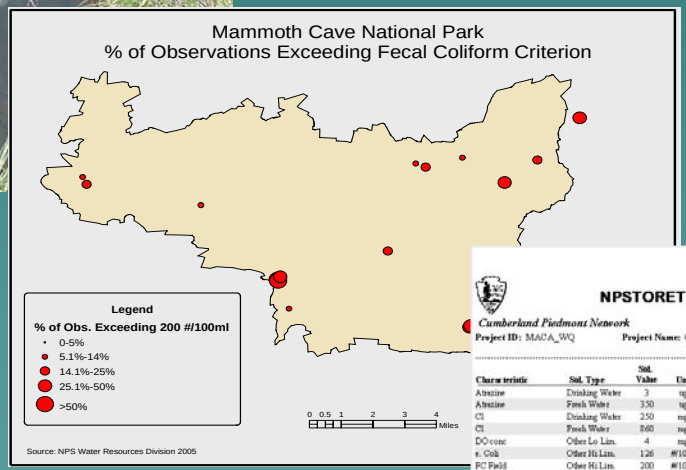
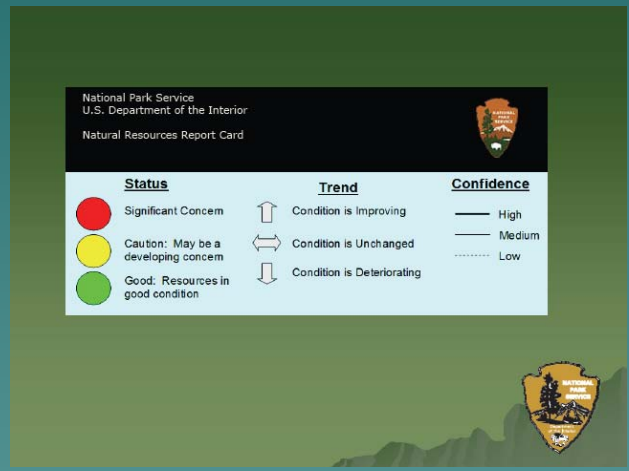
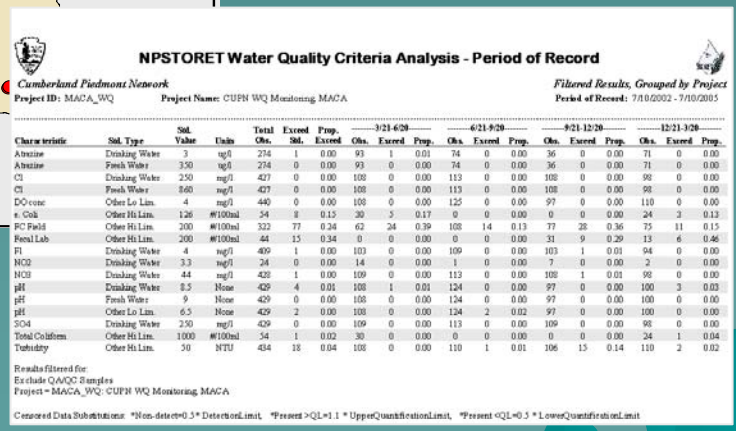
SERVICEWIDE VITAL SIGNS WATER QUALITY MONITORING

How are we doing integrating Science, Planning, and Management?

Gary Rosenlieb







NPSTORET Water Quality Criteria Analysis - Period of Record

Cumberland Piedmont Network — *Filtered Results, Grouped by Project*

Project ID: MACA_WQ **Project Name:** CUPN WQ Monitoring MACA **Period of Record:** 7/10/2002 - 7/10/2005

Characteristic	Std. Type	Std. Value	Units	Total Obs.	Exceed Std.	Prop. Exceed	3/21-6/20 Obs.	3/21-6/20 Exceed	3/21-6/20 Prop.	6/21-9/20 Obs.	6/21-9/20 Exceed	6/21-9/20 Prop.	9/21-12/20 Obs.	9/21-12/20 Exceed	9/21-12/20 Prop.	12/21-3/20 Obs.	12/21-3/20 Exceed	12/21-3/20 Prop.
Atrazine	Drinking Water	3	ug/l	274	1	0.00	93	1	0.01	74	0	0.00	36	0	0.00	71	0	0.00
Atrazine	Fresh Water	3.50	ug/l	274	0	0.00	93	0	0.00	74	0	0.00	36	0	0.00	71	0	0.00
Cl	Drinking Water	250	mg/l	427	0	0.00	108	0	0.00	113	0	0.00	102	0	0.00	98	0	0.00
Cl	Fresh Water	860	mg/l	427	0	0.00	108	0	0.00	113	0	0.00	108	0	0.00	98	0	0.00
DO conc	Other Lo Lim.	4	mg/l	440	0	0.00	108	0	0.00	125	0	0.00	97	0	0.00	110	0	0.00
e. Coli	Other Hi Lim.	126	#/100ml	54	8	0.15	20	3	0.17	0	0	0.00	0	0	0.00	24	2	0.13
FC Field	Other Hi Lim.	200	#/100ml	322	77	0.24	62	24	0.39	108	14	0.13	77	28	0.36	75	11	0.15
Fecal Lab	Other Hi Lim.	200	#/100ml	44	15	0.34	0	0	0.00	0	0	0.00	31	9	0.29	13	6	0.46
Fl	Drinking Water	4	mg/l	409	1	0.00	103	0	0.00	109	0	0.00	103	1	0.01	94	0	0.00
NO2	Drinking Water	3.3	mg/l	24	0	0.00	14	0	0.00	1	0	0.00	7	0	0.00	2	0	0.00
NO3	Drinking Water	44	mg/l	428	1	0.00	109	0	0.00	113	0	0.00	108	1	0.01	98	0	0.00
pH	Drinking Water	8.5	None	429	4	0.01	108	1	0.01	124	0	0.00	97	0	0.00	100	3	0.03
pH	Fresh Water	9	None	429	0	0.00	108	0	0.00	124	0	0.00	97	0	0.00	100	0	0.00
pH	Other Lo Lim.	6.5	None	429	2	0.00	108	0	0.00	124	2	0.02	97	0	0.00	100	0	0.00
SO4	Drinking Water	250	mg/l	429	0	0.00	109	0	0.00	113	0	0.00	109	0	0.00	98	0	0.00
Total Coliform	Other Hi Lim.	1000	#/100ml	54	1	0.02	30	0	0.00	0	0	0.00	0	0	0.00	24	1	0.04
Turbidity	Other Hi Lim.	50	NTU	434	18	0.04	108	0	0.00	110	1	0.01	106	15	0.14	110	2	0.02

Results filtered for:
Exclude QA/QC Samples
Project = MACA_WQ: CUPN WQ Monitoring MACA

Censored Data Substitutions: *Non-detect=0.5 * DetectionLimit, *Present >QL=1.1 * UpperQuantificationLimit, *Present <QL=0.5 * LowerQuantificationLimit

The Law:

NATIONAL PARKS OMNIBUS MANAGEMENT ACT OF 1998

"The Secretary shall undertake a program of inventory and monitoring of National Park System resources to establish baseline information and to provide information on the long-term trends in the condition of National Park System resources. The monitoring program shall be developed in cooperation with other Federal monitoring and information collection efforts to ensure a cost-effective approach."

What are Vital Signs?

Vital Signs are key elements that indicate the health of an ecosystem. Vital signs may occur at any level of organization including landscape, community, population, or genetic levels. They may be compositional (referring to the variety of elements in the system), structural (referring to the organization or pattern of the system), or functional (referring to ecological processes). Vital signs can be any measurable feature of the environment that provides insights into the state of the ecosystem.

"Focus on most significant indicators of long-term ecological trends and highest concerns among the parks in each network"


Olympic NP
North Cascades NP
Prairie Cluster
North Coast and Cascades
Rocky Mountain
Northern Semi-Arid
Klamath
Greater Yellowstone
Northern Great Plains
Great Lakes
Northeast Temperate
Cape Cod NS
Eastern Rivers and Mountains
Northeast Coastal and Barrier
Sierra
San Francisco Bay
Northern Colorado Plateau
Heartland
Mojave Desert
Mammoth Cave NP
National Capital
Northern Colorado Plateau Cluster
Shenandoah NP
Channel Islands NP
Southern Colorado Plateau
Cumberland/ Piedmont
Mid-Atlantic
Mediterranean Coast
Southern Plains
Appalachian Highlands
Sonoran Desert
Southeast Coast
Great Smoky Mountains NP
Gulf Coast
Chihuahuan Desert
Denali NPP
Northwest Alaska
Central Alaska
South Florida/Caribbean
Southwest Alaska
Pacific Islands
South Florida / Caribbean Cluster

Monitoring Plan Outline
Three-Phase Approach

- Chapter 1. Introduction and Background
- Chapter 2. Conceptual Ecological Models
- Chapter 3. Vital Signs
- Chapter 4. Sampling Design
- Chapter 5. Sampling Protocols
- Chapter 6. Data Management
- Chapter 7. Data Analysis and Reporting
- Chapter 8. Administration/Implementation of the Monitoring Program
- Chapter 9. Schedule
- Chapter 10. Budget
- Chapter 11. Literature Cited
    - Three-year process from start of plan to final.

Purpose of Vital Signs Water Quality Monitoring

- Track and Support Attainment of NPS and DOI Strategic Goals
  - Protect pristine water quality (e.g., ONRW)
  - Support additional CWA protections for unimpaired water
- Improve Impaired Water Quality
  - Support CWA provisions for improving water quality (TMDL Development)

Core Parameters

- Required Parameters at all monitoring sta.
  - Water Quality (4 – water column field meas.)
    - Temperature (degrees Celsius)
    - Specific Conductance (uS/cm.)
    - pH Standard pH Units
  - Dissolved Oxygen mg/l
  - Water Quantity (quantitative* or qualitative)
    - Flow or Discharge (flowing waterbody)
    - Stage/Level (non-flowing waterbody)
  - Photographic Documentation
    - **Minimum record of one digital site photo**

PROTOCOL DEVELOPMENT

Guidelines for long-term monitoring protocols

Karen L. Oakley, Lisa P. Thomas, and Steven G. Fancy

Abstract Monitoring protocols are detailed study plans that explain how data are to be collected, managed, analyzed, and reported, and are a key component of quality assurance for natural resource monitoring programs. Protocols are necessary to ensure that changes detected by monitoring actually are occurring in nature and not simply a result of measurements taken by different people or in slightly different ways. We developed and present here guidelines for the recommended content and format of monitoring protocols. The National Park Service and United States Geological Survey have adopted these guidelines to assist scientists developing protocols for more than 270 national park units.

Key words format, guidelines, monitoring, national park, natural resources, policy, protocol, sampling

Natural resource monitoring is "the collection and analysis of repeated observations or measurements to evaluate changes in condition and progress toward meeting a management objective" (Elzinga et al. 1998:1). To be certain that changes detected by monitoring are actually occurring in nature and not simply a result of measurements taken by different people or in slightly different ways, detailed and exacting monitoring protocols should be developed and implemented as part of all long-term monitoring programs (Geoghegan et al. 1999, Shampine 1993, Geoghegan 1996, Beard et al. 1999). Monitoring protocols are 1) a key component of quality assurance for monitoring programs to ensure that data meet defined standards of quality with a known level of confidence, 2) necessary for the program to be credible so that data stand up to external review, 3) necessary to detect changes over time and with changes in personnel, and 4) necessary to allow comparisons of data among places and agencies.

As part of planning and designing a long-term natural resource monitoring program for more than 270 national parks in the United States, scientists from the Inventory and Monitoring Program of the National Park Service (NPS) and the Status and Trends Program of the United States Geological Survey (USGS) have been working together to develop protocols for sampling natural resources in national parks. We developed these guidelines for protocol content and format to help overcome the unique challenges posed by long-term monitoring. The 2 agencies have adopted the following guidelines to assist scientists in developing protocols for the national parks. Ultimately, improving the quality of protocols is required for the program to meet its goal of detecting changes in the status and trends of ecosystems under the protection and management of the NPS.

Recommended content and format for monitoring protocols

Designing a monitoring project is like getting a tattoo: you want to get it right the first time because making major changes later can be messy and painful. Monitoring projects that incorporate a large up-front investment in defining objectives, optimizing sampling designs, and determining how monitoring results will be used are more likely to succeed over the long term. Consequently, an effective monitoring protocol will provide more than a

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SOP 2: Training Observers
SOP 3: Using the Global Positioning System
SOP 4: Establishing and Marking Sampling Plots
SOP 5: Conducting the Variable Circular Plot Count
SOP 6: Documenting Habitat Variables
SOP 7: Data Management
SOP 8: Data Analysis
SOP 9: Reporting
SOP10: Procedures and Equipment Storage After the Field Season
SOP11: Revising the Protocol

Is it worth the extra effort?

Writing protocols to the level of detail we recommend will require more effort than is devoted to such activities in the typical 2–5-year research project. However, to be certain that changes detected by long-term monitoring are actually occurring in nature, and not simply a result of measurements taken by different people or in slightly different ways, the methods used must be carefully documented. Substantial work is required to develop and test monitoring methods to ensure they will be consistent and comparable over periods from decades to centuries. To fully realize the investment in the monitoring program, protocols must meet a higher standard.

Improving the comparability of data from different locations is critical to much-needed integration of our nation's environmental monitoring efforts (Committee on Environment and Natural Resources 1997). Improving the quality of protocols, as we recommend, will facilitate data comparability and integrated assessments of the status and trends of our ecosystems.

Literature cited

Beard, G. R., W. A. Scott, and J. E. Anderson. 1999. The value of consistent methodology in long-term environmental monitoring. Environmental Monitoring and Assessment 54:239–258.

Committee on Environment and Natural Resources. 1997. Integrating the Nation's environmental monitoring and research networks and programs. A proposed framework. United States National Science and Technology Council, Washington, D.C., USA.

Table 1. Guidelines for long-term monitoring protocols: recommended content of the protocol narrative.

1. Background and objectives
   a. Background and history; describe resource issue being addressed
   b. Rationale for selecting this resource to monitor
   c. Measurable objectives
2. Sampling design
   a. Rationale for selecting this sampling design over others
   b. Site selection
      i. Criteria for site selection; define the boundaries or "population" being sampled
      ii. Procedures for selecting sampling locations; stratification, spatial design
   c. Sampling frequency and replication
   d. Recommended number and location of sampling sites
   e. Recommended frequency and timing of sampling
   f. Level of change that can be detected for the amount/type of sampling being instituted.
3. Field methods
   a. Field season preparations and equipment setup (including permitting and compliance procedures)
   b. Sequence of events during field season
   c. Details of taking measurements, with example field forms
   d. Post-collection processing of samples (e.g., lab analysis, preparing voucher specimens)
   e. End-of-season procedures
4. Data handling, analysis, and reporting
   a. Metadata procedures
   b. Overview of database design
   c. Data entry, verification, and editing
   d. Recommendations for routine data summaries and statistical analyses to detect change
   e. Recommended reporting schedule
   f. Recommended report format with examples of summary tables and figures
   g. Recommended methods for long-term trend analysis (e.g., every 5 or 10 years)
   h. Data archival procedures
5. Personnel requirements and training
   a. Roles and responsibilities
   b. Qualifications
   c. Training procedures
6. Operational requirements
   a. Annual workload and field schedule
   b. Facility and equipment needs
   c. Startup costs and budget considerations
7. References

Great Lakes Network

Large Rivers Water Quality Monitoring Protocol

National Park Service
Great Lakes Inventory and Monitoring Network

Version 1.0

January 30, 2007

Prepared by: S. Magdalene, D.R. Engstrom, J. Elias
Version: 1.0

Contact Information:
Great Lakes Inventory & Monitoring Network – National Park Service
2800 Lake Shore Drive East
Ashland, Wisconsin 54806
http://www.nature.nps.gov/im/units/glkn/

Suggested citation: Magdalene, S., D.R. Engstrom, and J. Elias. 2007. Large rivers water quality monitoring protocol. Version 1.0. National Park Service, Great Lakes Network, Ashland, Wisconsin.

Greater Yellowstone Network

REGULATORY
WATER QUALITY
MONITORING PROTOCOL

Version 2.0
June 1, 2006

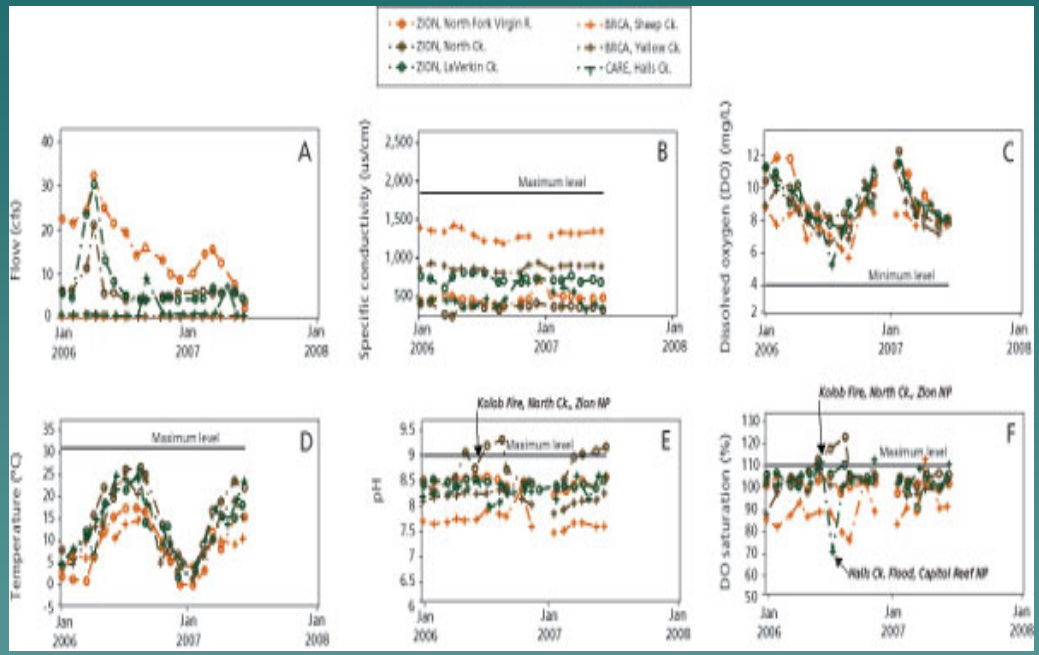
Greater Yellowstone
Inventory & Monitoring Network

Prepared by: Susan E. O'Ney
Version: 2.0

Contact Information:
Greater Yellowstone Inventory & Monitoring Network – National Park Service
Room 229, AJM Johnson Hall
P.O. Box 172780
Bozeman, Montana 59717
http://www1.nature.nps.gov/im/units/gryn/index.shtml

Suggested citation: O'Ney SE. 2006. Regulatory water quality monitoring protocol. Version 2.0. Bozeman (MT): National Park Service, Greater Yellowstone Network.

Northern Colorado Plateau Network



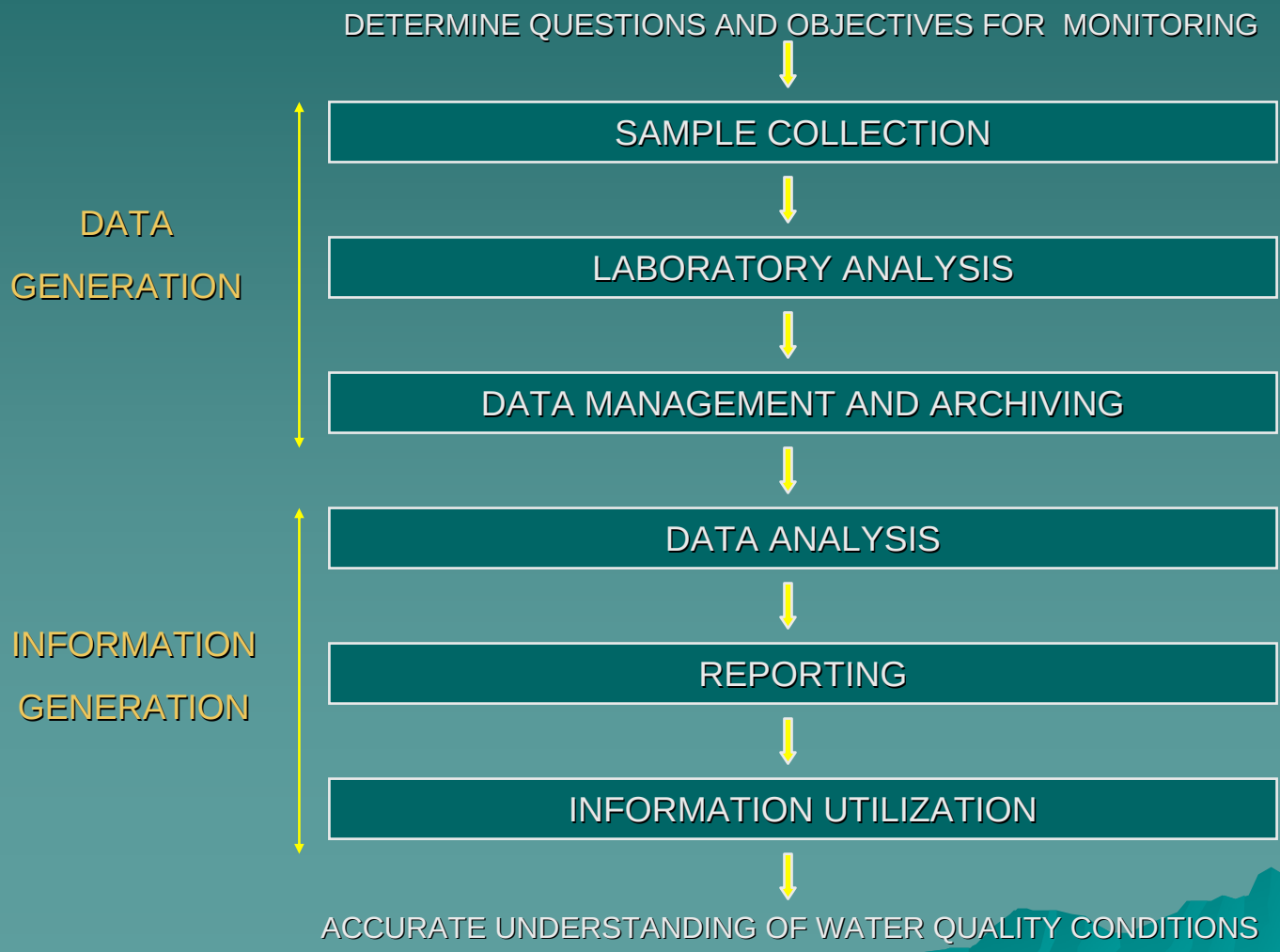
- Most Northern Colorado Plateau Network (NCPN) parks are located in semi-arid to arid environments where water is a major factor in determining the distribution of flora, fauna, and historic human habitation. Additionally, the abundance and quality of water resources reflect human activities and land use in and near parks, and are a primary factor influencing park visitation and recreational activities. Water bodies in national parks are protected by the Clean Water Act and other policies that prevent unacceptable levels of pollution and establish acceptable values for other water-quality measures. Park managers need information on status and trends in surface-water quality and quantity to comply with the Clean Water Act and to mitigate historic and future impacts to park water resources that may have ecological and social significance.

What Is A Water Quality Monitoring Program?

Best viewed as a Water Quality Information System that facilitates the flow of information between monitoring components resulting in management utilization of the information.

WATER QUALITY INFORMATION SYSTEMS

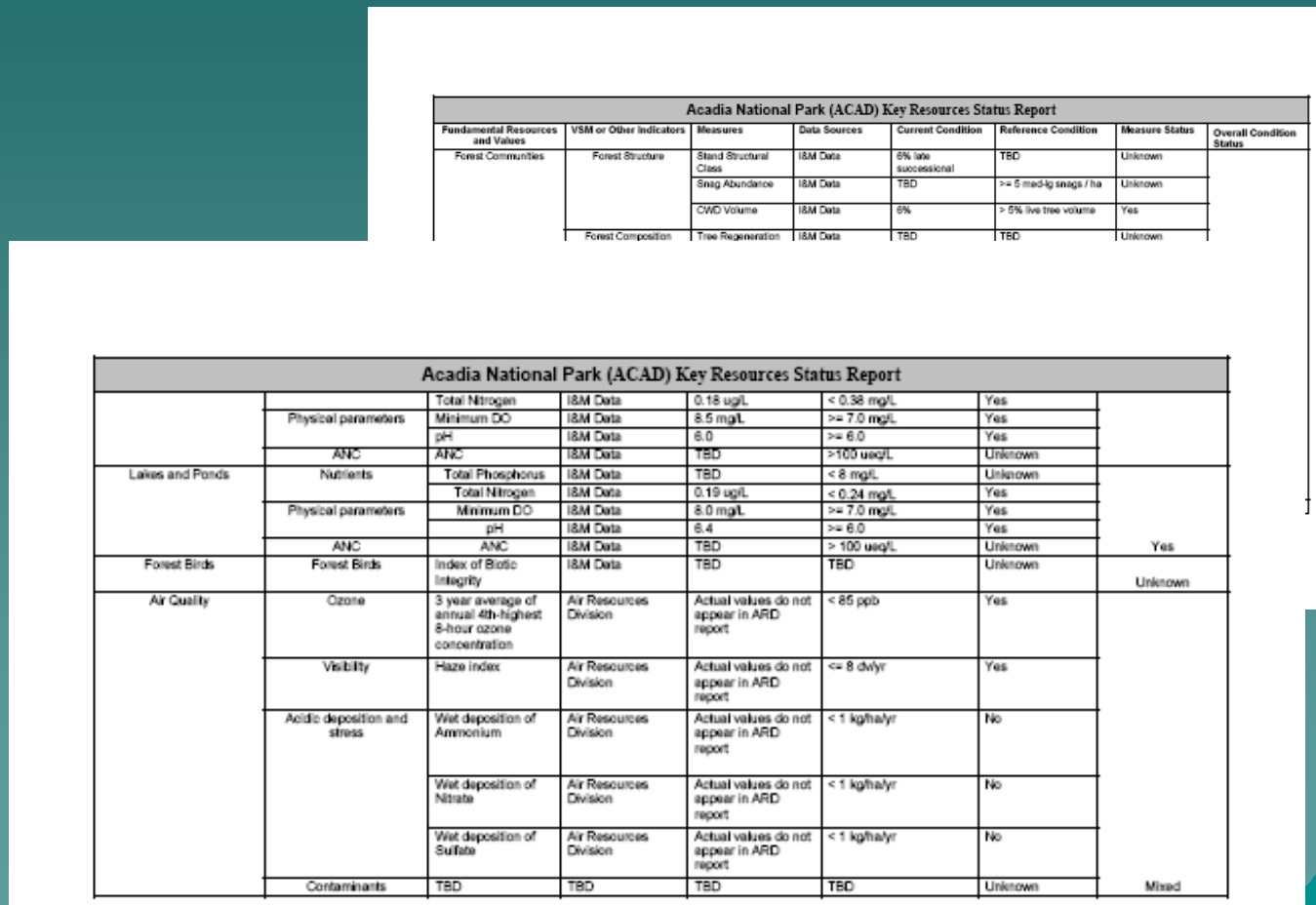
(MODIFIED FROM WARD 1990, DESIGN OF WATER QUALITY MONITORING SYSTEMS)



Current Natural Resource Reporting

- President's Management Agenda
  - Department Scorecard
- OMB → Budget
  - Performance, Accountability, Efficiencies
    - PART
    - Expect More
- DOI and NPS
  - Strategic Planning
  - GPRA
    - Landscapes and Watersheds
    - Biological Resources
  - Performance Management
    - STTS
- Natural Resources
  - Report to Congress

KEY RESOURCES STATUS REPORTS



Acadia National Park (ACAD) Key Resources Status Report

Fundamental Resources and Values	VSM or Other Indicators	Measures	Data Sources	Current Condition	Reference Condition	Measure Status	Overall Condition Status
Forest Communities	Forest Structure	Stand Structural Class	I&M Data	6% late successional	TBD	Unknown	
		Snag Abundance	I&M Data	TBD	>= 5 med-lg snags / ha	Unknown	
		CWD Volume	I&M Data	6%	> 5% live tree volume	Yes	
	Forest Composition	Tree Regeneration	I&M Data	TBD	TBD	Unknown	

Acadia National Park (ACAD) Key Resources Status Report

		Total Nitrogen	I&M Data	0.18 ug/L	< 0.38 mg/L	Yes	
	Physical parameters	Minimum DO	I&M Data	8.5 mg/L	>= 7.0 mg/L	Yes	
		pH	I&M Data	6.0	>= 6.0	Yes	
	ANC	ANC	I&M Data	TBD	>100 ueq/L	Unknown	
Lakes and Ponds	Nutrients	Total Phosphorus	I&M Data	TBD	< 8 mg/L	Unknown	
		Total Nitrogen	I&M Data	0.19 ug/L	< 0.24 mg/L	Yes	
	Physical parameters	Minimum DO	I&M Data	8.0 mg/L	>= 7.0 mg/L	Yes	
		pH	I&M Data	6.4	>= 6.0	Yes	
	ANC	ANC	I&M Data	TBD	> 100 ueq/L	Unknown	Yes
Forest Birds	Forest Birds	Index of Biotic Integrity	I&M Data	TBD	TBD	Unknown	Unknown
Air Quality	Ozone	3 year average of annual 4th-highest 8-hour ozone concentration	Air Resources Division	Actual values do not appear in ARD report	< 85 ppb	Yes	
	Visibility	Haze index	Air Resources Division	Actual values do not appear in ARD report	<= 8 dv/yr	Yes	
	Acidic deposition and stress	Wet deposition of Ammonium	Air Resources Division	Actual values do not appear in ARD report	< 1 kg/ha/yr	No	
		Wet deposition of Nitrate	Air Resources Division	Actual values do not appear in ARD report	< 1 kg/ha/yr	No	
		Wet deposition of Sulfate	Air Resources Division	Actual values do not appear in ARD report	< 1 kg/ha/yr	No	
	Contaminants	TBD	TBD	TBD	TBD	Unknown	Mixed

THE PLAN

Natural Resource "Scorecard(s)"

- Initial approach to report to GPRA and DOI Land Health Goals

- Long-term approach to synthesizing overall park natural resource conditions
  - Role of I&M Program
  - Role of Watershed Assessments